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Lorenzo Lamberti

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WORK EXPERIENCE

09/2020 – CURRENT – Bologna, Italy

PH.D. STUDENT – UNIVERSITY OF BOLOGNA

Ph.D. student: PULP-Lab, supervised by Dr. Luca Benini.
Research topics: *i)* artificial intelligence for aerial nano-robotics: visual-based autonomous navigation algorithms for nano-drones, using the Bitcraze Crazyflie coupled to the AI-deck visual engine, and focusing on training, quantization, and in-field deployment of deep neural networks, *ii)* Development of NAS (Neural Architecture Search) techniques for automated Deep Neural Networks topology design on constrained MCUs. *Open-source: www.github.com/pulp-platform/pulp-dronet*
Lab tutor at UniBo: "Architectures for Artificial Intelligence M" (2021) and "Hardware/Software Design Methodologies M" (2021) courses.
Student thesis supervision: 7 in UniBo, 4 in ETH Zürich.
Academic Publications: 4 (+2 accepted).
Secondary reviewer for conferences: DATE2021 (Design, Automation and Test in Europe Conference), Computing Frontiers 2022.
Extra: examining board member for Italian's state exams of engineering (Jul 2021, Nov 2021). Graduate students must take this exam to work as professionals.

Electrical, Electronic, and Information Engineering "Guglielmo Marconi" - DEI | www.pulp-platform.org |

Viale del Risorgimento, 2, 40136, Bologna, Italy

02/2020 – 08/2020 – Bologna, Italy

AI EMBEDDED APPLICATION ENGINEER – GREENWAVES TECHNOLOGIES

Evaluation of deep learning algorithms for Optical Character Recognition (OCR). The goal is to develop a lightweight 2-step Deep Learning model for visual-only license plate detection (SSD) and text recognition (LPRNet). The pipeline must be deployed on a ultra-low-power MCU, satisfying these constraints: fitting in 8Mb of L3 memory, not making use of any recurrent NNs, and it must run at least at 1 FPS (real-time). The final CNN model was deployed on GAP8, the industry's first ultra-low-power processor that enables battery-operated artificial intelligence (AI) in Internet of Things (IoT) applications.
Open-sourced at: www.github.com/LorenzoLamberti94/license-plates-ocr

www.greenwaves-technologies.com | Viale Carlo Pepoli 3, 40123 , Bologna, Italy

02/2019 – 08/2019 – Pasadena, California, United States

INTERNSHIP - AI RESEARCH INTERN AT DATALOGIC – DATALOGIC USA

Master's Degree thesis (6 months). Development of a deep learning system for industrial optical character recognition (OCR) applications. A general purpose object detection algorithm -- You Only Look Once (YOLO) -- was specialized for the specific task of reading character strings. The system was based only on convolutional neural networks (CNNs) and both accuracy and speed constrains were taken into account while developing the solution. The final model reached accuracy levels over 99.75% on 4 internal datasets, while running in real time (60-120 FPS on a Nvidia GTX1080).

www.datalogic.com/ | 55W Del Mar blvd, 91105, Pasadena, CA, United States

10/2017 – 03/2019 – Bologna, Italy

DEGREE PROGRAMME TUTOR – UNIVERSITY OF BOLOGNA

Degree Programme Tutor for the Chemichal Engineering Bachelor's Degree at University of Bologna. The roles of the tutor are: participating into orientation activities, supporting the Degree's Coordinator Professor in managing students' practices, collecting surveys of students' opinions about the teaching activities, and helping solving logistics or organization problems encountered by the students.

Administrative and support service activities | www.unibo.it |

Viale del Risorgimento 2, 40136 , Bologna, Italy

07/2018 – 09/2018 – Batavia (Chicago), Illinois, United States

INTERNSHIP - SCIENTIFIC COMPUTING DIVISION AT FERMILAB – FERMI NATIONAL ACCELERATOR LABORATORY

Development of machine learning algorithms (based on analytical techniques) to analyze monitoring data streams from Fermilab's global computing grid, in order to rapidly detect and identify aberrant conditions such as: faulty grid nodes, network bottlenecks, system faults.

Scientific Computing Division | https://www.fnal.gov |

Pine Street and Kirk Rd, 60510, Batavia (Chicago), Illinois, United States

EDUCATION AND TRAINING

12/2016 – 12/2019 – Viale del Risorgimento 2, Bologna, Italy

MASTER'S DEGREE IN ELECTRONIC ENGINEERING – Alma Mater Studiorum - University of Bologna

Field(s) of study

- Electronic Engineering

Thesis: Deployment of a deep learning solution for industrial OCR applications

110 / 110 cum laude | EQF level 7 | ECTS | 120

09/2013 – 12/2019 – Viale del Risorgimento 2, Bologna , Italy

BACHELOR'S DEGREE IN ELECTRONIC AND TELECOMMUNICATIONS ENGINEERING – Alma Mater Studiorum - University of Bologna

Field(s) of study

- Electronic and Telecommunications Engineering

Thesis: Analysis of the use of wearable inertial sensors for the recognition of daily activities

110 / 110 cum laude | EQF level 6 | ECTS | 180

LANGUAGE SKILLS

Mother tongue(s): **ITALIAN**

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken production	Spoken interaction	
ENGLISH	C1	C1	C1	C1	C1

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

DIGITAL SKILLS

Deep Learning Tools

PyTorch | TensorFlow | Keras | OpenCV

Programming

Python | C | Git | Linux | LaTeX | VHDL | Verilog | Pascal | XML | HTML | VSCode IDE

Software applications

Quartus-Altera | Synopsys (RTL Synthesis) | LTspice | Advanced Design System (ADS) - Keysight | Model Sim-Altera | MATLAB | Cadence-Virtuoso | LabVIEW | VirtualBox | Android Studio | Monitoring Tools: Grafana, Kibana

PUBLICATIONS

Pruning In Time (PIT): A Lightweight Network Architecture Optimizer for Temporal Convolutional Networks

Design Automation Conference (DAC)
2021
Paper: https://ieeexplore.ieee.org/document/9586187
Open-sourced at: https://github.com/matteorisso/PIT

Improving Autonomous Nano-Drones Performance via Automated End-to-End Optimization and Deployment of DNNs

Journal on Emerging and Selected Topics in Circuits and Systems (JETCAS)
2021
Paper: https://ieeexplore.ieee.org/document/9606685/
Open-sourced at: https://github.com/pulp-platform/pulp-dronet

Automated Tuning of End-to-end Neural Flight Controllers for Autonomous Nano-drones

Artificial Intelligence Circuits and Systems (AICAS)
2021
Paper: https://ieeexplore.ieee.org/document/9458550

Low-Power License Plate Detection and Recognition on a RISC-V Multi-Core MCU-based Vision System

International Symposium on Circuits and Systems (ISCAS)
2021
Paper: https://ieeexplore.ieee.org/document/9401730
Open-sourced at: https://github.com/LorenzoLamberti94/license-plates-ocr

Tiny-PULP-Dronets: Squeezing Neural Networks for Faster and Lighter Inference on Multi-Tasking Autonomous Nano-Drones

2022
Artificial Intelligence Circuits and Systems (AICAS) -- *accepted, not published*

Lightweight Neural Architecture Search for Temporal Convolutional Networks at the Edge

2022
Transactions on Computers Journal -- *accepted, not published*

Reducing Neural Architecture Search Spaces with Training-Free Statistics and Computational Graph Clustering

2022
Poster session -- ACM International Conference on Computing Frontiers -- *accepted, not published*
arXiv: https://arxiv.org/abs/2204.14103

CONFERENCES AND SEMINARS

16/04/2021
Speaker -- AI-deck workshop

Workshop on the AI-deck in collaboration with Bitcraze company. The AI-deck is a pluggable PCB developed by the PULP team that provides enough computational power for executing visual-based artificial intelligence algorithms aboard nano-drones.
Topics: Hardware explanation (GAP8 SoC and AI-deck specifics), software preliminaries, hands-on examples (live).
Slides/code: https://github.com/pulp-platform/AI-deck-workshop
Video: https://youtu.be/o9asYPHxEB4
Event: www.bitcraze.io/about/events/adws12021/

STUDENT'S PROJECTS SUPERVISION

2021 – CURRENT

University of Bologna -- ETH Zürich

University of Bologna:

- Aurora Di Giampietro, Bachelor's Thesis. Title: "Study of Deep Learning Algorthms for Object Detection aboard Nano-Drones". (06/2021 - 10/2021)
- Manuel Cintura, Master's Thesis. Title: "An Embedded Data Logger for In-Vehicle Testing". (03/2021 - 10/2021)
- Luca Bompiani. Semester Thesis. Title: "Deployment of an SSDLite Object Detector on a Nano-Drone using the GAPflow toolset". (12/2021 - 03/2022)
- Luca Bompani, Master's Thesis. Title: "Robust Object Detection Methods for Nano-Drones". (03/2022 - ongoing)
- Davide Graziani, Bachelor's Thesis. Title: "Development of Autonomous Exploration Algorithms for Nano-Drones using Time-of-Flight sensors". (11/2021 - 05/2022)
- Lorenzo Squarzoni, Bachelor's Thesis. Title: "Shrinking Techniques for Deploying Object Detection Algorithms aboard Nano-Drones". (11/2021 - ongoing)
- Giulia Kodric', Bachelor's Thesis. Title: "Evaluation of SoA object detection algorithms for nano-drones". (04/2022 - ongoing)

ETH Zürich:

- Daniel Ribien, Semester Thesis. Title: "Dataset building framework for PULP-based nano-drones". (02/2021 - 06/2021)
- Mark Vero, Semester Thesis. Title: "Hardware Constrained Neural Architecture Search: An Analysis of the Training-Free Framework". (03/2021 - 07/2021)
- Dimitrios Christodoulou, Semester Thesis. Title: "Deep Learning-based Global + Local Planner for Autonomous Nano-drones". (02/2021 - ongoing)
- Zichong Li, Semester Thesis. Title: "Sensor Fusion for Improved Collision Avoidance for Nano-drones". (05/2021 - ongoing)